CLAIMS

1. A method of automatically calibrating a water distribution model of a water distribution network, including the steps of:

    (A) selecting calibration parameters including at least one of pipe roughness, junction demand, and link status;

    (B) collecting field observed data including a pipe flow measurement and a junction pressure measurement for at least one point in the water distribution network, and including corresponding loading conditions and boundary conditions that existed in the network when said field observed data was collected;

    (C) generating a population of trial solutions that comprise a set of calibration results, using a genetic algorithm; and

    (D) running multiple hydraulic simulations of each trial solution to obtain a set of predictions of pipe flows and junction pressures at selected points in the network, corresponding to the different loading conditions and associated boundary conditions when the field observed data was collected.

2. The method of automatically calibrating a water distribution model as defined in claim 1, including performing a calibration evaluation including the steps of:

    (A) computing a goodness-of-fit value for each calibration solution;

    (B) assigning the goodness-of-fit value for each solution as the fitness for that entry into a genetic algorithm; and

    (C) searching for optimized solutions using said genetic algorithm.

3. The method of automatically calibrating a water distribution model as defined in claim 2, including the further step of:

    (A) selecting a weighting function for at least one of said field observed data measurements; and

(B) applying said weighting function when running said calibration evaluation to determine said goodness-of-fit value.

4. The method of automatically calibrating a water distribution model, as defined in claim 1, including the further step of:

selecting as said loading condition, at least one water demand loading at a predetermined time of day, corresponding to a time of day when a field observed data measurement has been made.

5. The method of automatically calibrating a water distribution model, as defined in claim 4, including the further step of selecting multiple loading conditions representing demand loading at various times of day when field observed data measurements have been made.

6. The method of automatically calibrating a water distribution model as defined in claim 1 wherein said boundary conditions include water storage tank levels, pressures control valve settings and pump operation speeds.

7. The method of automatically calibrating a water distribution model as defined in claim 1 including the further step of:

after said optimized set of calibration data is obtained, making manual adjustments to this information for said water distribution model calibration.

8. The method of automatically calibrating a water distribution network model as defined in claim 1, including the further step of performing a sensitivity analysis by varying model input parameters over a predetermined range and observing the response thereto of said model.

9. The method of automatically calibrating a water distribution network model as defined in claim 8 including the further step of adjusting the collection of field observed samples based upon the results of said sensitivity analysis.

10. A system embodied in a software program for automatically calibrating a water distribution model of a water distribution network that has links that include pipes and junctions, the system comprising:

(A) a user interface coupled with an associated work station into which the user may enter data concerning field observed measurements for the network, and may make other entries and selections;

(B) a calibration module having software programming that produces calibration information for a water distribution model constructed from user-selected calibration parameters that include at least one of pipe roughness, junction demand information and link status;

(C) a genetic algorithm module coupled to said calibration module and said user interface such that information about said calibration parameters, and user-entered field observed data may be operated upon to produce a population of trial solutions including calibrated pipe flows and hydraulic grade line pressures for predetermined portions of said network; and

(D) a hydraulic network simulation module coupled in communicating relationship with said genetic algorithm module such that solutions generated by said genetic algorithm module can be run by said hydraulic network simulation module to predict actual behavior of said network.

11. The system as defined in claim 10, wherein said calibration module further includes calibration evaluation programming that computes a goodness-of-fit value for each trial solution generated by said genetic algorithm.

12. The system as defined in claim 11, wherein said genetic algorithm module further includes optimization programming that repetitively computes successive generations of

solutions based upon said fitness information calculated by said calibration module to at least one optimal solution.

13. The system as defined in claim 10 further comprising:

a database including information regarding water distribution networks for constructing models of said networks.

14. The system as defined in claim 10 wherein said user interface further allows a user to enter information regarding alternative demand loadings, representing a demand for water supply at a given point in time, at a given location in the network.